housed in the pivoting front part of the pod, and are mounted so as to pivot with this front part relative to the stationary rear part of the pod and the corresponding fixed wing.

On a helicopter, it is known practice to absorb main rotor lift by a set of suspension struts, suspending on the structure of the helicopter a main gearbox mounted between the engine or engines driving the main rotor and the latter, this set of suspension struts comprising at least three and generally four rigid struts, substantially rectilinear, distributed around the main gearbox and inclined towards each other and towards the axis of rotation of the rotor shaft at their upper ends at which the suspension struts are articulated to the upper part of the main gearbox casing, which also comprises a lower part of the casing attached to the upper part of the casing, while the suspension struts are integral with the structure of the helicopter at their lower ends, articulated on fittings integral with the transmission support platform of the structure.

The upper and lower parts of the casing are rigidly assembled to each other by a ring of threaded studs which at the same time secure to the casing an outer peripheral gearwheel of an epicyclic train, constituting an output stage of a pivoting reduction gear unit housed in the casing, and such that the planet gear carrier of the epicyclic train is integral in rotation, about the axis of rotation of the rotor, with the drive shaft mounted rotatably in the upper part of the casing by rolling bearings, including a thrust bearing axially retaining the drive shaft in the upper part of the casing, while the sun gear of the epicyclic train is integral in rotation with a bevel or spiral bevel gear meshed with a bevel or spiral bevel input gear of a pair of bevel gears, constituting another reduction stage housed in the lower part of the casing, and such that the bevel input gear shaft is driven from the engine or engines.

In an architecture of this type, all the loads and bending moments applied to the top of the shaft driving the rotor pass through all of the gears and other toothed components housed in the casing. The deformation of the casing under these loads must therefore be precisely known, in order that the bearing surfaces and contact areas on the bevel or spiral bevel gears can be optimised.

casing about said pivot axis, said drive shaft being retained axially by at least one thrust bearing in a part of said upper casing having a generally convergent external shape, which converges towards one end of said drive shaft projecting out of said casing and connected in rotation to a rotor, wherein said upper casing cooperates with an arrangement configured to transfer to said support via said pivot bearings at least an axial load experienced by said drive shaft during use.

With this architecture of the power transmission unit, in order to reduce very substantially the loads, and therefore the deformation, in the gears of the drive train enclosed in the pivoting power transmission unit, it is proposed by the invention that the pivoting casing of the power transmission unit of the invention should absorb the lift loads applied to the corresponding rotor, in helicopter mode, and/or the thrust loads applied to the rotor in aeroplane mode, these lift and/or thrust loads corresponding to an axial load on the drive shaft of each rotor, and should transfer them directly to the structure of the convertible aircraft, or more generally, to the structure integral with the support on which the casing of the transmission unit is mounted so as to pivot.

For an application to wind turbines and to convertible aircrafts with tilting rotors, the invention proposes a pivoting power transmission unit the casing of which also transfers the loads due to the moments and efforts applied to the end of the drive shaft connected to the rotor hub, directly to the load-carrying structure and not to the components (gears and gearwheels) constituting the drive train housed in the transmission unit.

In a first mode of embodiment, the arrangement for transferring to the support at least the axial load applied to the drive shaft comprise a set of at least three suspension struts, by which the pivoting casing is suspended on the swivelling parts of the two pivot bearings, the suspension struts being rigid, substantially rectilinear, inclined to the axis of rotation so as to converge towards each other and towards said axis of rotation at their ends facing towards said rotor, and distributed about said axis of rotation, each of said suspension struts being articulated, at a first end, to said convergent part of

about an axis perpendicular to a diametral plane passing through the axis of rotation, at each of its two articulated joints.

An embodiment of this type, in which the lift or thrust is passed by the suspension struts and the pivot bearings to the load-carrying structure, means that a rigid assembly of the upper casing to the lower casing is retained and at the same time an attachment provided for a toothed component of the gearing inside the casing, as is known and presented above in helicopter main gearboxes. Thus, in the transmission unit according to the invention, at least one stage of gears of this unit may advantageously be at least partially enclosed by said lower casing and comprise an outer peripheral annular gear, attached to the inside of said lower casing by fasteners of the threaded stud type, making the upper and lower casings integral with each other, particularly when the outer peripheral annular gear is that of an epicyclic train mounted as an output reduction stage for driving the rotor shaft, in the transmission unit according to the invention.

This first embodiment, with suspension struts, requires a relatively long assembly time, as these struts must be perfectly adjusted and the structure as a whole is relatively heavy, due to the weight of the struts and the weight of the attachment lugs of the swivelling parts of the bearings.

To eliminate these disadvantages, and to obtain a transfer of loads which is not limited to lift or thrust, but also involves the moments and shear forces at the top of the drive shaft, the invention proposes a second embodiment of the casing, wherein the arrangement for transferring to the support at least the axial load applied to the drive shaft comprises a skirt extending from the upper casing at one end opposite to the rotor and outside said lower casing, the skirt having at least two cylindrical arc-shaped portions, coaxial about said pivot axis and each attached to one respectively of the swivelling parts of the bearings, said upper casing being mounted on said lower casing by a swivel coupling for swivelling about a part of said lower casing defining its maximum cross-section, perpendicularly to said axis of rotation, said lower casing being also attached to said swivelling parts of the bearings.

In order that the lift and thrust loads applied to the rotor mast 22 do not pass through the assembly of gears and gearwheels of the reduction gear unit housed in the transmission unit 1, the upper casing 3 cooperates with an arrangement for transferring these loads to the support 8, via the pivoting bearings 5, and in the example in figures 1 and 2, these transfer means comprise essentially a set of four rigid struts 28 for suspension of the pivoting casing 2 on the swivelling parts 6 of the two pivot bearings 5, two suspension struts 28 only being shown in figures 1 and 2.

These struts 28, two of which are located on the same side as one of the bearings 5, and the other two on the same side as the other bearing 5, are substantially rectilinear struts, inclined to the axis of rotation A-A of the rotor 25, so as to converge towards each other and towards this axis A-A at their ends facing towards the rotor 25, and these four struts 28 are distributed about the axis of rotation A-A and each articulated, by a swivel end 29 at a first end, to lugs 30 attached, projecting radially (relative to the axis A-A) towards the outside at the end of the upper casing 3 located at the same end as the rotor 25, and by another swivel end 31 at its other end, to one of two attachment lugs 32 projecting radially outwards on the rotating part 6 of the corresponding pivot bearing 5, these two lugs 32 being symmetrical with each other relative to the plane defined by the two axes A-A and B-B, and these two lugs 32 being preferably diametrically opposite relative to the pivot axis B-B.

The suspension struts 28 thus extend outside the pivoting casing 2, each between an attachment projecting outwards and defined by one or two corresponding attachment lugs 30 on the narrow end of the upper casing 3, towards the rotor 5, and an articulated attachment on the swivelling part 6 of the corresponding bearing 5, by the corresponding lug 32, which may where appropriate be double or take the form of a yoke in which the swivel of the corresponding end fitting of the strut 28 is retained.

This assembly ensures that the articulation points of the struts 28 of each of the two pairs of struts associated respectively with the swivelling part 6 of one respectively of the bearings 5 are substantially diametrically opposite relative to the pivot axis B-B.

Because it is connected to the attachment lugs 30 and 32 by the swivel ends 29 and 31 respectively, each suspension strut 28 is articulated at least so that it can swivel about an axis which is perpendicular to the local diametral plane passing through the axis of rotation A-A of the rotor 25 and through the centre of the swivel at each of the two articulations at the swivel ends 29 and 31.

With an embodiment of this type, the thrust or lift loads applied to the rotor mast 22 are introduced, via the thrust bearing 27, into the narrowest part of the upper casing 3, which carries the attachment lugs 30, by which these loads are introduced into the suspension struts 28 and transmitted, via the lugs 32. to the swivelling parts 6 of the two pivot bearings 5, of which the stationary parts 7, on which the swivelling parts 6 are able to rotate, transmit these loads to the support 8 and therefore to the load-carrying structure.

On the other hand, the shear forces and bending moments applied at the top of the rotor mast 22 always pass through the gears and gearwheels of the reduction gear stages of the pivoting transmission unit 1.

The second example of a pivoting power transmission unit, shown in figures 3 to 7, not only ensures that the lift and thrust loads are not made to pass through the gears and gearwheels of the transmission stages of the pivoting power transmission unit, but also secures the same advantage for moments and shear forces, applied at the head of the rotor mast, and which are transmitted, as is the lift or the thrust, to the structure by transfer means cooperating with the upper casing, though without including suspension struts, and therefore without incurring penalties in weight because of the presence of the suspension struts and also of the attachment lugs, and in assembly times, due to the fact that such suspension struts must be perfectly adjusted in length.

The pivoting transmission unit 41 in figures 3 to 7, which also includes a reduction gear assembly consisting, as in the example in figures 1 and 2, of a bevel or spiral bevel gear input module or stage 9 with the bevel or spiral-bevel gears and an output module or stage 10 which is an epicyclic stage (so that the components of this reduction gear unit are referred to in figures 3 to 7 by

also has an internal and annular radial flange 66 to which is attached the outer peripheral annular gear 17 of the epicyclic output reduction gear stage 10, by a set of threaded fasteners, such as studs or screws, marked by their axes 67, so that this peripheral annular gear 17 is attached to and enclosed by this end part 44a of the lower casing 44 without being attached to the upper casing 43.

This flexible peripheral swivelling seal 62, shown in figures 3 and 7, allows limited-amplitude swivelling movements of the upper casing 43 on the lower casing 44, so as to avoid any unwanted loads or moments being introduced into the power train constituted by the stages of gears and toothed components housed in the casing 42. The shear forces and bending moments originating from the rotor mast 22 pass through the structure of the upper casing 43, by reason of at least one rolling thrust bearing guiding the mast 22 in the upper end of the upper casing 43, as in the example in figures 1 and 2, then these loads and moments are transmitted to the swivelling parts 46 of the pivot bearings 45, and finally to the non-pivoting support 48 and the stationary structure 52, without affecting the lower casing 44 nor the gearing housed in the casing 42.

Only the reaction torque to the drive torque is transferred to the lower casing 44, by reason of the attachment of the outer annular gear 17 of the epicyclic stage 10 to the lower casing 44 only. The lower part of the skirt 43b of the upper casing 43, in particular the four feet 51, because of their shape, incorporate the functions of the suspension struts described in the example in figures 1 and 2. The loads coming from the rotor mast 22 are transmitted directly to the structure 52, without passing through the gearing housed in the transmission unit 41, which considerably reduces the deformation of the gears and toothed components of this assembly. This makes it correspondingly easier to optimise the contact surfaces of the teeth. The shear forces and bending moments between the feet 51 of the upper casing 43 and the swivelling parts 46 of the bearings 45 pass through the fasteners 60, while the upper casing 43 is no longer attached to the lower casing 44 in the area of the stationary peripheral annular gear 17 of the epicyclic stage 10, and is able